



Sungkyunkwan University (SKKU) International Summer Semester (ISS) 2017  
"New Experience, New Engagement"

# Applying Game Theory in International Relations

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## SHORT COURSE DESCRIPTION

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"Game theory is a mathematical theory dealing with models of conflict and cooperation" (Tijds 2003: 1). As such, the theory of games seems an obvious instrument for analysing opposing interests in international politics. The course is non-technical introduction for students and scholars. We present the traditional games and we discuss some applications of game theory in international politics. We start with introducing zero-sum games, positive-sum games, cooperative games and so on. Game theory is for most scholars an interesting analytic tool for studying actual conflicts. Some conflicts, like the Cuban Missile Crisis, have been studied extensively and by using models of the theory of games we can enhance our understanding. The combination of a textbook introduction of game theory with some applications in international politics will be interesting for the reader who wants to familiarise himself with models of conflict and cooperation. Some scholars want to use game theory for clarifying the underlying conflict of interests between nations. In order to be able to use game theory correctly one has to have knowledge of the theory of games. Also if one reads about conflicts in international politics that includes some game theoretical analysis, one must have some basic knowledge of game theory to understand the argument of the author(s).

## READING MATERIALS

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The literature contains chapters of the book (forthcoming 2017)

Huib Pellikaan,                    A New Introduction to Game Theory  
   with Applications in International Relations

All literature (15 chapters, 300 pages) will be available for free on ISS website and students find them on the web and they can download the book for free to read.

## COURSE REQUIREMENTS AND GRADING

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In the first meeting (27 June) we discuss the use of game theory in (social) science, and we give a general idea what is expected of the students during the course. For example, how to answer the exercises. There are 14 assignments in the period (28 June – 17 July) and each assignment contains 3 exercises, thus during the course a student can make 42 exercises. Each student must have a sufficient for 30 exercises in order to pass the course. This means that the retake is built in the course. Each must be present for at least 12 meetings. Both requirements (i) making at least 30 sufficient exercises, and (ii) be present at least 12 meetings, will determine the pass/ fail ruling.

SKKU regulations require students to attend at least 80% of all classes.

### Grading

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|----------------------------------|------|
| Reading Presentation (exercises) | 80%  |
| Class Participation              | 20%  |
| Total                            | 100% |

## COURSE SCHEDULE

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### – WEEK I –

#### Tuesday (27 June)

- The lecture in the first meeting of the course will be an overview of the topics in game theory. Game theory is about *Conflict and Cooperation*.
- Preparatory reading: *Chapter 1 Theory of Games*
- No assignments

#### Wednesday (28 June)

- The roots of game theory lie in the duopoly theory of Cournot and the bargaining theory of Edgeworth. The first one explains *Conflict* and the second one describes *Cooperation*.
- Preparatory reading: *Chapter 2 Conflict and Cooperation*
- Assignments:
  - Exercise 2.1 Discuss briefly the difference between non-cooperative games and cooperative games.
  - Exercise 2.2 Explain the difference in the outcome of the non-cooperative game (Figure 3) and the cooperative game (Figure 5).
  - Exercise 2.3 Discuss the first proposition of Putnam: *Larger win sets make Level I agreement more likely (ceteris paribus)*.

#### Thursday (29 June)

- The lecture is an introduction in zero-sum games in which games in normal form and sequential games will be discussed
- Preparatory reading: *Chapter 3 Two-person zero-sum games*
- Assignments:
  - Exercise 3.1 Explain why players have to use mixed strategies in the games Matching Pennies and Rock, Paper, Scissors.
  - Exercise 3.2 Explain the maximin strategy in the game 'Battle of the Bismarck Sea'.
  - Exercise 3.3 Explain what the concept of a 'saddle point' means in the context of zero-sum games.

#### Friday (30 June)

- The lecture is an introduction in positive-sum games in which games in normal form and sequential games will be discussed
- Preparatory reading: *Chapter 4 Two-person positive-sum games*
- Assignments:
  - Exercise 4.1 Explain the difference in the solution of the game between a Chicken Game in normal form and a Chicken Game in extensive form.
  - Exercise 4.2 Explain the maximizing rules  $A_3$  and  $A_4$  of Rapoport and Guyer as an alternative for the concept of a Nash equilibrium
  - Exercise 4.3 Explain why the mixed strategy is not problematic in the context of a zero-sum game, but the mixed strategy is problematic in a positive-sum game.

– WEEK II –

Monday (3 July)

- The foreign policy of Mutual Assured Destruction and the policy of Massive Retaliation is analysed with games and we discuss these games.
- Preparatory reading: *Chapter 5 Nuclear Deterrence*
- Assignments:
  - Exercise 5.1 Present the General Deterrence Game (Figure 2) and discuss the underlying assumptions of the preferences of the two players.
  - Exercise 5.2 Discuss the role of the Protégé in the Three-person Extended Deterrence Game of Quackenbush (Figure 8).
  - Exercise 5.3 Explain the dashed curve in the Nuclear Deterrence Game in Figure 18.

Tuesday (4 July)

- There are different versions of deterrence theories and authors use game theory to make their point in the debate between these theories. The central notion in the debate is the credibility of a threat which is formalised by the Harsanyi Game.
- Preparatory reading: *Chapter 6 Credibility of a Threat*
- Assignments:
  - Exercise 6.1 What is, according to Zagare, the logical inconsistency of the classic deterrence theory.
  - Exercise 6.2 Explain why for nuclear deterrence we must use symmetric games instead of the Rudimentary Asymmetric Deterrence Game.
  - Exercise 6.3 Why is, according to Harsanyi, the outcome (1, 3) not a reasonable equilibrium in the Harsanyi Game in normal form.

Wednesday (5 July)

- The lecture is an introduction to the iterated Prisoner's Dilemma game in which players play several rounds against each other.
- Preparatory reading: *Chapter 7 The Evolution of cooperation*
- Assignments:
  - Exercise 7.1 Explain why the Flood-Dresher experiment is actually a game against the bank.
  - Exercise 7.2 Explain why the strategy Tit For Tat is doing so well against the nice rules as well as against the so-called meanies in the tournament (compared to the other computer strategies).
  - Exercise 7.3 Explain whether the claim of Axelrod is valid that Tit For Tat demonstrates the possibility of cooperation, given that the setting of the game is supposed to be Hobbes' state of nature.

Thursday (6 July)

- The strategic considerations in a three-person game changes severely since the forming of a coalition with two players is the only thing that matters.
- Preparatory reading: *Chapter 8 Three-person Coalition Game*
- Assignments:
  - Exercise 8.1 Discuss the solution of Von Neumann and Morgenstern of the three-person zero-sum game (Table 1)
  - Exercise 8.2 Explain why the win set model and the three-person game are similar.
  - Exercise 8.3 Explain what happens if we give each player in the three-person game the choice between Cooperate and Defect (Figure 5).

### Friday (7 July)

- Robin Farquharson introduced a three-person voting model which is not a coalition game and it is not a simple majority game. Farquharson has created a unique way to model a three-person game.
- Preparatory reading: *Chapter 9 Three-person Voting Theory*
- Assignments:
  - Exercise 9.1 Discuss the characteristics of the solution of the zero-sum coalition game Farquharson-style (Figure 4)
  - Exercise 9.2 Discuss the characteristics of the solution of the positive-sum coalition game Farquharson-style (Figure 5) and compare the result with coalition game of Von Neumann and Morgenstern.
  - Exercise 9.3 Discuss the notion of 'unitary actor' with the Cuban Missile Crisis game in Figure 10.

### - WEEK III -

### Monday (10 July)

- The foundation of the modern cooperative game is the bargaining model of Francis Edgeworth, a nineteenth century Irish economist and moral philosopher. For Edgeworth, was measuring pleasure no different than measuring energy.
- Preparatory reading: *Chapter 10 Two-person Bargaining*
- Assignments:
  - Exercise 10.1 Explain what a Pareto efficient distribution means.
  - Exercise 10.2 Explain why the assumption of interpersonal comparison of utility is so important in a bargaining model.
  - Exercise 10.3 Explain Figure 11 with the ideal point with indifference contours.

### Tuesday (11 July)

- A negotiation model focuses on specific issues and we need a two-dimensional model to illustrate the trade-off between a bundle of goods and the sizes of budgets for different policies. A bargaining model is part of the category of cooperative games.
- Preparatory reading: *Chapter 11 Two-dimensional Spatial Models*
- Assignments:
  - Exercise 11.1 Explain why a circle in a two-dimensional model with substantive dimensions violates the economic laws of Gossen.
  - Exercise 11.2 Explain why the likelihood of a fair division is very small in our model In Figure 18.
  - Exercise 11.3 Explain why the solution in the Bargaining model in Figure 18 is a better outcome than the other two points on the Pareto boundary.

### Wednesday (12 July)

- The debate between the scholars of the classical deterrence theory and the perfect deterrence theory reveals different views on the rationality of deterrence
- Preparatory reading: *Chapter 12 Conventional Deterrence*
- Assignments:
  - Exercise 12.1 Explain the difference between the Nuclear Deterrence game and the New (non-nuclear) Deterrence game.
  - Exercise 12.2 Explain what the problem is with the craft of international history for constructing preferences.
  - Exercise 12.3 Who determines the success or failure of a conventional deterrence game?

#### Thursday (13 July)

- There is no valid method to establish the 'true' preferences. With the revealed preference method we can circumvent this problem since we are no longer searching for the 'true' preferences, but we use the facts of the actual behaviour of the actors.
- Preparatory reading: *Chapter 13 Revealed Preferences*
- Assignments:
  - Exercise 13.1 What is the assumption of rationality according to Arrow? Discuss the Axioms.
  - Exercise 13.2 Explain why cases 19 to 36 in Table 2 are not suitable preferences for a deterrence game.
  - Exercise 13.3 Explain the difference between game theory on the one hand and the substantive theories in international relations toward the preferences of the actor (state).

#### Friday (14 July)

- The reveal preference method will give us a set of possible preferences and with the notion of the 'ordering of orderings' we can rank the orderings from "not aggressive" to "most aggressive". With the lottery ticket method of Von Neumann and Morgenstern we can determine utility values.
- Preparatory reading: *Chapter 14 Hawks and Doves in a Chicken Game*
- Assignments:
  - Exercise 14.1 Explain the concept of the 'ordering of the orderings'.
  - Exercise 14.2 Explain the method of lottery tickets.
  - Exercise 14.3 Explain why players would prefer the maximin outcome of the Chicken Game to a mixed Nash equilibrium.

### – WEEK IV –

#### Monday (17 July)

- We replace the classic mixed strategies by our new calculation of mixed strategies and the result is a three-dimensional model that looks like a upward-facing dragonfly.
- Preparatory reading: *Chapter 15 Upward-Facing Dragonfly*
- Assignments:
  - Exercise 15.1 Explain the crucial difference between the classic mixed strategies and our alternative method for mixed strategies.
  - Exercise 15.2 Explain how the solution of the three-dimensional model replaces the rule  $A_3$  and  $A_4$  of Rapoport and Guyer.
  - Exercise 15.3 Discuss the view that we do not need the concept of a Nash equilibrium for determining the rational choice of a player.